MIL-S-24236B
26 April 1972
SUPERSEDING
MIL-S-24236A
30 April 1969

MILITARY SPECIFICATION

SWITCHES, THERMOSTATIC, (METALLIC AND BIMETALLIC)

GENERAL SPECIFICATION FOR

This specification is approved for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers the general requirements for metallic-element actuated, thermostatic switches intended primarily for use in electrical and electronic equipment, in alternating current (ac) and direct current (dc) applications, where temperature protection, overheat detection, or accurate temperature control of an enclosure is required. The operating temperatures and operating temperature ranges of switches covered by this specification shall be as specified (see 3.1 and 6.1.2).

1.2 Classification. Switches covered by this specification shall be classified by type and class as indicated herein (see 3.1 and 6.1.2).

Type I	-	Snap action, make and break operation.
Type II	-	Slow make and break operation
Class 1	-	Altitude - Sea level to 10,000 feet. Vibration - 10-55 Hertz (Hz), .06 double amplitude. Shock - 75G, 6 milliseconds (ms).
Class 2	-	Altitude - Sea level to 10,000 feet Vibration - 10-55 Hz, .06 double amplitude. Shock - High impact.
Class 3	-	Altitude - Sea level to 70,000 feet Vibration - 10-500 Hz, 10G. Shock - 75G, 6 ms.
Class 4	-	Altitude - Sea level to 70,000 feet. Vibration - 10-2,000 Hz, 20G. Shock - 100G, 6 ms
Class 5	-	Altitude - Sea level to 100,000 feet Vibration - 10-3,000 Hz, 50G. Shock - 500G, 1 ms.
* Class 6	-	Altitude - Sea level to 100,000 feet Vibration - 10-2,000 Hz, 30G. Shock - 100G, 6 ms

* 2 APPLICABLE DOCUMENTS

2.1 The following documents, of the issue in effect on date of invitation for bids or request for proposal, form a part of this specification to the extent specified herein

SPECIFICATIONS

FEDERAL

ZZ-R-765 - Rubber Silicone Low- and High-Temperature and Tear Resistant.

FSC 5930

MILITARY

MIL-I-10	-	Insulating Materials, Electrical, Ceramic, Class L
MIL-M-14	-	Molding Plastics and Molded Plastic Parts, Thermosetting
MIL-W-5086	-	Wire, Electric, Hookup and Interconnecting, Polyvinyl Chloride-Insulated, Copper or Copper Alloy Conductor
MIL-C-5809	-	Circuit Breakers, Trip-Free, Aircraft, General Specification for.
MIL-T-7928	-	Terminals, Lug Splices, Conductor Crimp Style, Copper, General Specification for.
MIL-F-15160	-	Fuses, Instrument, Power, and Telephone
MIL-S-28786	-	Switches, Preparation for Delivery of
MIL-C-45662	-	Calibration System Requirements

(See Supplement 1 for list of applicable specification sheets.)

STANDARDS

MILITARY

MIL-STD-105	-	Sampling Procedures and Tables for Inspection by Attributes.
MIL-STD-202	-	Test Methods for Electronic and Electrical Component Parts
MIL-STD-1276	-	Leads, Weldable, for Electronic Component Parts
MIL-STD-1285	-	Marking of Electrical and Electronic Parts.

(Copies of specifications, standards, drawings, and publications required by suppliers in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer)

2 2 Other publications The following document forms a part of this specification to the extent specified herein. Unless otherwise indicated, the issue in effect on date of invitation for bids or request for proposal shall apply.

NATIONAL BUREAU OF STANDARDS

Handbook H28 - Screw-Thread Standards for Federal Services

(Application for copies shall be addressed to the Superintendent of Documents, Government Printing Office, Washington, D C 20402.)

3. REQUIREMENTS

3.1 Detail requirements for individual switches The individual part requirements shall be as specified herein and in accordance with the applicable specification sheets Where there is no specification sheet available, the individual part requirements shall be as specified in complementary documents, such as service drawings or ordering data (see 6.1.2). In the event of any conflict between requirements of this specification and the specification sheet or complementary document, the latter shall govern (see 6 1)

* 3.2 Switch categories. Switches furnished under this specification shall be category I or II, as defined herein.

3.2 1 Category I Switches completely defined by a military specification sheet

3.2.2 Category II. Switches the same as category I, except for minor differences such as terminations, mounting means, or temperature settings, which do not change the basic design or construction of the qualified switch Category II shall be procured from a source listed on the applicable qualified products list for the particular similar product in category I. Category II switches are nonstandard.

3.3 Qualification. Category I switches furnished under this specification shall be products which are qualified for listing on the applicable qualified products list at the time set for opening of bids.

3.4 Material. Material shall be as specified herein. However, when a definite material is not specified, a material shall be used which will enable the switches to meet the performance requirements of this specification. Acceptance or approval of any constituent material shall not be construed as a guaranty of the acceptance of the finished product.

* 3 4 1 Plastic. Unless otherwise specified (see 3 1 and 6.1.2), molded plastic material shall conform to MIL-M-14, except that cotton, wood, or cellulose-filled molding materials shall not be used. Flame retardant or type "SDGF" plastics shall be used whenever practical.

3 4 1 1 Thermoplastics Thermoplastics shall not be used.

3 4 2 Metals. All metal parts exposed to environmental conditions shall be of a corrosion-resistant material or shall be suitably plated to resist corrosion.

3 4 2.1 Dissimilar metals When dissimilar metals are used in intimate contact with each other, protection against electrolysis and corrosion shall be provided The use of dissimilar metals in contact, which tend toward active electrolytic corrosion (particularly, brass, copper, or steel used in contact with aluminum or aluminum alloy), is not acceptable. However, metal-spraying or metal plating of dissimilar base metals to provide similar or suitable abutting surfaces is permitted. The use of dissimilar metals separated by a suitable insulating material is also permitted Dissimilar metals are defined in 6.3 through 6.3 4 and table VI, except that the use of corrosion resistant steel in contact with cadmium plating shall be allowed.

3.4 3 Rubber. All rubber shall be in accordance with ZZ-R-765.

3 4 4 Ceramic. Ceramic insulation shall be grade L411 or higher, in accordance with MIL-I-10.

3 4 5 Weldability. Leads designed for weldability shall conform to requirements of MIL-STD-1276, type K

3.4.6 Screw terminals. Screw terminals shall be provided with hardware as specified (see 3.1 and 6.1.2). Lockwashers shall be captive to the screw. For direct Government orders, all terminal hardware shall be assembled in proper order.

3.5 Design and construction. Switches covered by this specification shall be of the design, construction, and physical dimensions specified (see 3.1 and 6.1.2). Switches shall be so constructed as to insure proper operation when mounted in any position.

3.5.1 Hermetic enclosure (when applicable, see 3.1 and 6.1.2) A hermetic enclosure shall be constructed so as to be gas tight by complete sealing of glass or ceramic to metal or bonding metal to metal by fusion, and unless otherwise specified (see 3.1 and 6.1.2), hermetically sealed switches shall be sealed by soldering, welding, or brazing. Sealed switches shall be dried and backfilled with dry gas with a dew point less than -65° C.

3.5.2 Tamperproof calibration. Unless otherwise specified (see 3.1 and 6.1.2), the switches shall be so sealed that any tampering with the calibration after final adjustment by the manufacturer shall require dismantling of the switch or the breaking of a seal The seal shall not be easily broken by manual force or without the use of any device considered a tool, for example, screwdriver, pliers, soldering iron, and so forth.

3.5.3 Environmental test effect (unless otherwise specified, see 3.1) Exposure to any single environmental test shall not change the initial operation point by more than ±3° F. Exposure to two or more environmental tests shall not change the initial operation point by more than ±5° F.

3.5.4 Solder terminals. Solder terminals shall be treated to facilitate soldering. The terminal design shall be such that a mechanical connection can be made prior to soldering. Acceptable solder terminal designs are turret, hook, pierced, or post type.

3.5.5 Mounting. Mounting shall be as specified (see 3.1 and 6.1.2) Stud mounting shall have threads in accordance with Handbook H28.

3.5.6 Weight Weight shall be as specified (see 3.1 and 6.1.2)

3.6 Electrical ratings. The electrical ratings shall be as specified (see 3.1 and 6.1.2).

3.7 Solderability. When switches are tested as specified in 4.7.2, 95 percent of the total length of fillet, which is between the standard wrap wire and the terminal, shall be tangent to the surface of the terminal being tested. There shall be no pinholes, voids, and so forth. A ragged or interrupted line at the point of tangency between the fillet and the terminal under test shall be considered a defect After the test, there shall be no evidence of fracture, loosening of parts, or any other mechanical failure of the switches.

3.8 Calibration When switches are tested as specified in 4.7.3, the operating points for the opening and closing temperature shall be within the tolerances specified (see 3.1 and 6.1.2)

3.9 Creepage (applicable to type I switches only, see 3.1 and 6.1.2) When switches are tested as specified in 4.7.4, the opening and closing of switch contacts shall occur simultaneously with, and as a result of, the disc snap

3.10 Sensitivity response (when specified, see 3.1) When switches are tested as specified in 4.7.5.1, the time required for the switch to actuate and deactuate shall not exceed 10 seconds.

3.11 Temperature anticipation (when specified, see 3.1 and 6.1.2) When switches are tested as specified in 4.7.6, the switches shall not operate.

3.12 Seal (as applicable, see 3.1 and 6.1.2)

3.12.1 Hermetic. When switches are tested as specified in 4.7.7.1, the leakage rate shall not exceed 1 x 10^{-8} standard atmospheric cubic centimeters per second (atm cc/sec)

3.12.2 Watertight. When switches are tested as specified in 4.7.7.2, there shall be no leakage as evidenced by a continuous stream of bubbles.

3.13 Dielectric withstanding voltage. Unless otherwise specified (see 3.1 and 6.1.2), when switches are tested as specified in 4.7.8, there shall be no flashover, arcing, or current flow in excess of 500 microamperes.

3.14 Insulation resistance. When measured as specified in 4.7.9, the insulation resistance between all insulated terminals and enclosures shall be not less than 500 megohms.

3.15 Contact resistance. Unless otherwise specified (see 3.1 and 6.1.2), when measured as specified in 4.7.10, the initial contact resistance shall not exceed 50 milliohms, following the endurance test, contact resistance shall not exceed 100 milliohms.

3.16 Thermal shock. When switches are tested as specified in 4.7.11, there shall be no mechanical or electrical damage. The temperature settings shall be within the opening and closing temperature tolerances as specified (see 3.1, 6.1.2, and 3.5.3)

3.17 Terminal strength. When switches are tested as specified in 4.7.12, the terminals shall not break, loosen, crack, or affect the operation of the switch.

3.18 Moisture resistance. When switches are tested as specified in 4.7.13, the insulation resistance immediately after conclusion of the test shall be greater than 2 megohms at 500 Vdc. At the end of the drying period, the insulation resistance shall be as specified in 3.14. At the conclusion of the test, there shall be no evidence of corrosion or mechanical damage.

3.19 Flame response (when specified, see 3.1). When switches are tested as specified in 4.7.14, the time required for the switch to operate shall not exceed 5 seconds.

3.20 Short circuit. When switches are tested as specified in 4.7.15, there shall be no welding or sticking of contacts, or damage. Switches shall be mechanically and electrically operative at the end of the test.

3.21 Vibration. Unless otherwise specified (see 3.1, 6.1.2, and 3.5.3), when switches are tested as specified in 4.7.16, closing of open contacts and opening of closed contacts shall not exceed 10 microseconds

3.22 Shock. Unless otherwise specified (see 3.1, 6.1.2, and 3.5.3), when switches are tested as specified in 4.7.17, there shall be no change in operation, or evidence of broken, deformed, displaced, or loose parts.

3.22.1 Method I (shock, specified pulse) (applicable to classes 1, 3, 4, 5, and 6) (see 3.1 and 6.1.2). When switches are tested as specified in 4.7.17.1, closing of open contacts and chatter of closed contacts shall not exceed 10 microseconds, unless otherwise specified (see 3.1 and 6.1.2).

3.22.2 Method II (high-impact shock) (applicable to class 2 only, see 3.1 and 6.1.2). When switches are tested as specified in 4.7.17.2, closing of open contacts and chatter of closed contacts shall not exceed 5 milliseconds, unless otherwise specified (see 3.1 and 6.1.2).

3.23 Overload cycling. When switches are tested as specified in 4.7.18, there shall be no mechanical or electrical failure.

* 3 24 Endurance When tested as specified in 4 7 19, switches shall remain electrically operative Allowable tolerance during and after endurance shall be the initial tolerance and an additional ±5° F in the temperature range 0° F to 350° F, and an additional 8° F outside this range.

3 25 Salt spray (corrosion). When switches are tested as specified in 4 7.20, switches shall show no evidence of destructive corrosion After the test any mounting hardware (if applicable) shall be readily removable NOTE Destructive corrosion shall be construed as being any type of corrosion which in any way interferes with the mechanical or electrical performance, or in the case of plated metals, corrosion which has passed through the plating and attacked the base metal

3 26 Sand and dust (when specified, see 3 1) When switches are tested as specified in 4 7 21, the subsequent operating characteristics shall be as specified (see 3 1), and they shall be mechanically and electrically operative at the conclusion of the test

* 3 27 Explosion (when specified, see 3 1) When switches are tested as specified in 4 7 22, there shall be no explosion within the test chamber, whether or not explosion occurs within the switch, and the switches shall be electrically and mechanically operative after the test.

* 3 28 Marking. Switches shall be marked in accordance with MIL-STD-1285 with the military part number or the manufacturer's part number when specified (see 6 1 2), date code, and the manufacturer's trademark or code symbol For polarized switches, the plus terminal shall be marked with a + sign

* 3 28 1 Military part number When a military part number is not available, the temperature setting and contact arrangement shall be marked on the switches

3 29 Workmanship. Switches shall be processed in such a manner as to be uniform in quality and shall be free from cracked or displaced parts, sharp edges, burrs, and other defects which will affect life, serviceability, or appearance

4 QUALITY ASSURANCE PROVISIONS

4 1 Responsibility for inspection Unless otherwise specified in the contract or purchase order, the supplier is responsible for the performance of all inspection requirements as specified herein Except as otherwise specified in the contract or purchase order, the supplier may utilize his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements

4 1 1 Test equipment and inspection facilities Test and measuring equipment and inspection facilities of sufficient accuracy, quality and quantity to permit performance of the required inspection shall be established and maintained by the supplier The establishment and maintenance of a calibration system to control the accuracy of the measuring and test equipment shall be in accordance with MIL-C-45662

* 4 2 Classification of inspection. The inspections specified herein are classified as follows

(a) Materials inspection (see 4 3).
(b) Qualification inspection (see 4 5)
(c) Quality conformance inspection (see 4 6)

4 3 Materials inspection. Materials inspection shall consist of certification supported by verifying data that the materials listed in table I, used in fabricating the switches, are in accordance with the applicable referenced specification or requirements prior to such fabrication.

TABLE I Materials inspection.

Material	Requirement paragraph	Applicable specification
Plastic - - - - - - - - - -	3.4.1	MIL-M-14
Rubber - - - - - - - - - -	3.4.3	ZZ-R-765
Ceramic - - - - - - - - - -	3 4 4	MIL-I-10

4.4 Inspection conditions. Unless otherwise specified herein, all inspections shall be performed in accordance with the test conditions specified in the "GENERAL REQUIREMENTS" of MIL-STD-202.

4.5 Qualification inspection Qualification inspection shall be performed at a laboratory acceptable to the Government (see 6.2) on sample units produced with equipment and procedures normally used in production.

4 5 1 Sample size The number of switches to be subjected to qualification inspection shall be as specified (see 3.1 and table II)

4 5 2 Inspection routine. The sample shall be subjected to the inspections specified in table II, in the order shown All sample units shall be subjected to the inspections of groups I through V, in the order shown The sample shall be divided as specified in table II for groups II to IV inclusive, and subjected to the inspection for their particular group

4 5.3 Failures. One or more failures shall be cause for refusal to grant qualification approval.

4.5.4 Extent of qualification

4 5 4.1 Single submission. Qualification shall be restricted to the switch submitted.

4 5 4.2 Group submission If samples satisfactorily pass the qualification inspection, other switches from the same manufacturer that have the same operation, or reverse operation, design, construction, switching characteristics, class, and physical dimensions will be considered qualified by the Government without further qualification inspection.

4 5 4.3 Qualification by classes. Qualified switches of class 5 shall provide qualification for classes 6, 4, 3, 2 1/, and 1. Class 6 shall provide qualification for classes 4, 3, 2 1/, and 1 Class 4 shall provide qualification for classes 3, 2 1/, and 1. Class 3 shall provide qualification for classes 2 1/ and 1. Qualification will be granted for switches having tolerances and differentials greater than those qualified.

1/ For class 2 qualification, two additional sample units shall be subjected to calibration and high-impact shock tests specified in 4.7 3.1 and 4.7 17 2

TABLE II Qualification inspection

Examination or test	Requirement paragraph	Method paragraph
Group I (all sample units) 1/		
Visual and mechanical examination	3.1, 3 4, 3 5, 3.28 and 3.29	4 7.1
Solderability 2/	3 7	4 7.2
Calibration	3.8	4 7 3
Creepage (when applicable)	3 9	4 7 4
Sensitivity response	3 10	4 7.5 1
Temperature anticipation (when applicable)	3 11	4.7.6
Seal (as applicable)	3.12	4 7.7
Dielectric withstanding voltage	3 13	4 7 8
Insulation resistance	3 14	4 7.9
Contact resistance	3.15	4.7.10
Group II (3 sample units from group I)		
Thermal shock	3 16	4.7 11
Terminal strength	3.17	4 7.12
Moisture resistance	3 18	4 7.13
Flame response (when applicable)	3.19	4 7 14
Short circuit	3 20	4 7.15
Group III (4 sample units from group I) 1/		
Vibration	3 21	4 7.16
Shock	3.22	4 7.17
Overload cycling	3.23	4 7.18
Endurance 3/	3 24	4.7.19
Group IV (all sample units Group II and III)		
Visual and mechanical examination	3 1, 3.4, 3.5, 3 28 and 3 29	4.7.1
Calibration	3.8	4 7 3
Creepage (when applicable)	3 9	4.7 4
Sensitivity response	3.10	4.7.5.1
Temperature anticipation (when applicable)	3 11	4.7 6
Seal (as applicable)	3.12	4.7.7
Dielectric withstanding voltage	3.13	4.7.8
Insulation resistance	3.14	4.7 9
Contact resistance	3 15	4 7.10
Group V (4 sample units from group I) shall be included and identified in this group)		
Salt spray (corrosion)	3.25	4.7.20
Sand and dust (2 sample units) (when applicable)	3 26	4 7 21
Explosion (2 sample units) (when applicable)	3.27	4 7.22

1/ Total number of sample units is dependent upon the number of loads specified (see 3 1)
2/ Three sample units only
3/ Three sample units shall be tested at the lowest temperature at the rated ac resistive load for which qualification is sought (see 3 1).
Three sample units shall be tested at the midrange temperature at the rated ac resistive load for which qualification is sought (see 3 1)
Three sample units shall be tested at the highest temperature for which qualification is sought at each load specified (see 3.1).

* 4 5 5 Retention of qualification To retain qualification, the supplier shall forward a report at 24-month intervals to the qualifying activity. The qualifying activity shall establish the initial reporting date. The report shall consist of

(a) A summary of the results of the tests performed for inspection of product for delivery (group A), indicating as a minimum the number of lots that have passed and the number that have failed The results of tests of all reworked lots shall be identified and accounted for

(b) A summary of the results of tests performed for qualification verification inspection (group B), including the number and mode of failures The summary shall include results of all qualification verification inspection tests performed and completed during the 24-month period If the summary of the test results indicates nonconformance with specification requirements, and corrective action acceptable to the qualifying activity has not been taken, action may be taken to remove the failing product from the qualified products list

Failure to submit the report within 30 days after the end of each 24-month period may result in loss of qualification for the product. In addition to the periodic submission of inspection data, the supplier shall immediately notify the qualifying activity at any time during the 24-month period that the inspection data indicates failure of the qualified product to meet the requirements of this specification

In the event that no production occurred during the reporting period, a report shall be submitted certifying that the company still has the capabilities and facilities necessary to produce the item If during 3 consecutive reporting periods there has been no production, the manufacturer may be required, at the discretion of the qualifying activity, to submit a representative product of each type to testing in accordance with the qualification inspection requirements

4 6 Quality conformance inspection

4 6 1 Inspection of product for delivery Inspection of product for delivery shall consist of group A inspection

4 6 1 1 Inspection lot An inspection lot shall consist of all switches of the same type produced under essentially the same conditions, and offered for inspection at one time.

4 6 1 2 Group A inspection. Group A inspection shall consist of the examinations and tests specified in table III, in the order shown

4 6 1 2 1 Sampling plan Statistical sampling and inspection shall be in accordance with MIL-STD-105 for general inspection level II The acceptable quality levels (AQL) shall be as specified in table III. Major and minor defects shall be as defined in MIL-STD-105.

* TABLE III Group A inspection.

Examination or test	Requirement paragraph	Method paragraph	AQL (percent defective)	
			Major	Minor
Visual and mechanical examination - - - - - -	3 1, 3 4, 3 5, 3 28 and 3 29	4 7 1	1.0	4.0
Calibration - - - - - - - - - - - - - - - - - - -	3.8	4 7 3	1/	---
Creepage -	3 9	4 7 4	1/	---
Seal (as applicable) - - - - - - - - - - - - - -	3 12	4.7 7	1/	---
Dielectric withstanding voltage - - - - - - - -	3.13	4.7.8.1	0.65	---
Contact resistance - - - - - - - - - - - - - - -	3.15	4 7.10	0.65	---

1/ 100 percent inspection required, in process inspection may be used to satisfy this requirement.

4 6 1 2 2 Rejected lots. If an inspection lot is rejected, the supplier may rework it to correct the defects, or screen out the defective units, and resubmit for reinspection. Resubmitted lots shall be inspected using tightened inspection Such lots shall be separate from new lots, and shall be clearly identified as reinspected lots.

4 6 1 2 3 Disposition of sample units Sample units which have passed all the group A inspection may be delivered on the contract or purchase order, if the lot is accepted and the sample units are still within specified electrical tolerances

4 6 2 Qualification verification inspection Qualification verification inspection shall consist of group B, except where the results of these inspections show noncompliance with the applicable requirements (see 4 6 2 1 4), delivery of products which have passed group A shall not be delayed pending the results of this qualification verification inspection.

4 6 2 1 Group B inspection. Group B inspection shall consist of the examinations and tests specified in table IV, in the order shown Group B inspection shall be made on sample units selected from inspection lots which have passed the group A inspection

* 4 6 2 1 1 Sampling plan. Six sample units shall be selected for each type of switch produced, 12 months after the date of notification of qualification, and after each subsequent 24-month period. A supplier's normal quality control tests, production tests, environmental tests, and so forth, may be used to fulfill all or part of group B inspection, however, all of the group B inspection shall be completed as specified

TABLE IV Group B inspection.

Examination or test	Requirement paragraph	Method paragraph
Subgroup 1 (3 sample units)		
Thermal shock	3.16	4 7 11
Terminal strength	3 17	4.7 12
Moisture resistance	3 18	4 7 13
Flame response (when applicable)	3 19	4 7 14
Short circuit	3 20	4 7 15
Overload cycling	3 23	4.7 18
Subgroup 2 (3 sample units)		
Vibration	3 21	4 7 16
Shock	3.22	4 7 17
Endurance 1/	3 24	4 7 19
Subgroup 3 (3 sample units from subgroup II)		
Salt spray (corrosion)	3.25	4 7 20
Sand and dust (when applicable)	3 26	4.7 21
Explosion (2 sample units) (when applicable)	3 27	4 7 22
Subgroup 4 (all sample units)		
Visual and mechanical examination	3 1, 3 4, 3 5, 3 28 and 3 29	4 7 1
Calibration	3.7	4 7 3
Creepage (when applicable)	3 9	4 7 4
Sensitivity response (when applicable)	3 10	4 7 5.1
Temperature anticipation (when applicable)	3 11	4 7 6
Seal (as applicable)	3 12	4 7 7
Dielectric withstanding voltage	3 13	4 7 8 1
Insulation resistance	3 14	4 7 9
Contact resistance	3 15	4 7 10

1/ Endurance test to be performed at the highest temperature under the highest ac resistive load

4 6 2 1.2 Failures If one or more sample units fail to pass group B inspection, the sample shall be considered to have failed.

4 6 2 1 3 Disposition of sample units. Sample units which have been subjected to group B inspection shall not be delivered on the contract or purchase order

4 6 2 1 4 Noncompliance If a sample fails to pass group B inspection, the supplier shall take corrective action on the materials or processes, or both, as warranted, and on all units of product which can be corrected and which were manufactured under essentially the same conditions, with essentially the same materials, processes, and so forth, and which are considered subject to the same failures Acceptance of the product shall be discontinued until corrective action, acceptable to the Government, has been taken After the corrective action has been taken, group B inspection shall be repeated on additional sample units (all inspection, or the inspection which the original sample failed, at the option of the Government). Group A inspection may be reinstituted, however, final acceptance shall be withheld until the group B reinspection has shown that the corrective action was successful In the event of failure after reinspection, information concerning the failure and the corrective action taken shall be furnished to the cognizant inspection activity and the qualifying activity

* 4.6.3 Inspection of preparation for delivery. Sample packages and packs and the inspection of the preservation-packaging, packing and marking for shipment and storage shall be in accordance with the requirements of MIL-S-28786.

4 7 Methods of examination and test.

4 7 1 Visual and mechanical examination Switches shall be examined to determine that the materials, design, construction, physical dimensions, markings, and workmanship are in accordance with the applicable requirements (see 3.1, 3.4, 3.5, 3.28, and 3.29), and when specified, switches shall be X-rayed in two planes perpendicular to its axis to ascertain correct alinement of all internal actuating elements, the integrity of the unit, and any entrapped foreign matter

4 7 2 Solderability (see 3.7) Switches shall be tested in accordance with method 208 of MIL-STD-202. The following details and exception shall apply

(a) Number of terminations for each part to be tested - Two.
(b) Dipping device - Need not be used.
(c) Solder dip - Applicable.
(d) Examination of terminations - Method for evaluation of lugs and tabs shall apply

4 7.3 Calibration (see 3. 8). Switches shall be tested as specified in 4.7.3.1 for qualification, and as specified in 4.7.3.2 for quality conformance inspection. When disputes arise or different readings are encountered in the circulated-air method versus the liquid-bath method, the latter shall govern. This does not apply to the surface block method.

4.7.3.1 Method for qualification inspection. Switches submitted for qualification inspection shall have their operating points determined by one of the following methods or other suitable method.

(a) Liquid bath method - The switch shall be immersed in a well-agitated bath of a suitable liquid. In order to observe the operation of the contacts, the switch shall be connected to a suitable indicating circuit. When the temperature is within 5° F of the operating range, the rate of change shall not exceed 1° F per minute. To minimize parallax error in reading temperatures, the switch shall be run through three cycles; however, each reading shall be within the tolerances specified (see 3 1 and 6.1.2) and the operating temperatures shall be recorded for each cycle The average of the three readings shall be the operating temperature point.

(b) Circulating-air method - Use same procedure as in 4 7 3 1(a), except that the switch shall be placed in a circulating-air chamber The rate of temperature change shall not exceed 1° F per minute

(c) Surface block method - A block of high conductivity metal shall be used. The block shall have a means of adjusting its temperature and shall have been demonstrated to have a temperature gradient in the testing area of no more than 20 percent of the operating range of the switches to be tested, when its temperature is being varied at a rate of 2° F per minute. The device for indicating block temperature shall have an accuracy and readability of no more than 10 percent of the operating range of the switches to be tested, and shall have a response, as installed in the block, equal to or faster than the response of the switches to be tested. A conductive compound (grease) may be used between the switch mounting surface and the block. A low voltage lamp shall be used to indicate the opening and closing points of the switches The block, with switches attached, shall be stabilized at a temperature at least 5° F below the lowest operating point. The block temperature shall then be raised at no more than 1° F per minute until the switch operates, and then lowered at no more than 1° F per minute until the switch reoperates The switch shall be cycled three times and the three operating temperatures and three re-operating temperatures recorded. Each reading shall be within the tolerances specified (see 3.1 and 6.1.2). The average of the three readings shall be the operating temperature point

4 7 3 2 Method for quality conformance inspection. For quality conformance inspection, switches shall be tested by one of the following methods, or other suitable method. Throughout this test, X = upper operating temperature range, and Y = lower operating temperature range

4 7 3 2 1 Air-calibration method The switch shall be placed in a calibration chamber (see 4 7 3 1(b)) The switch shall be tested by a "go-no-go" method as used in inspection gages, or by recording individual temperatures of each switch

4 7 3 2.1.1 Individual temperature method The rate of temperature change shall not exceed 1/3° F per minute when the temperature is within 5° F of the operating range.

4 7 3 2 1 2 Go-no-go test procedure (for type 1 switches) The following tests may be entered at any step but tests must be conducted in the sequence shown with step 1 following step 4

Step 1 - Adjust the temperature of the chamber to X° F minimum minus 3° F Hold this temperature for three minutes minimum Adjust the chamber temperature to X° F minimum, and hold this temperature for a minimum of three minutes After this period, no switch shall have operated.

Step 2 - Adjust the chamber temperature to X° F maximum, and hold this temperature for six minutes minimum. After this period, all switches shall have operated.

Step 3 - Lower the chamber temperature to Y° F maximum plus 3° F and hold for three minutes minimum. Lower temperature to Y° F maximum and hold this temperature for three minutes minimum. After this period, no switch shall have operated.

Step 4 - Lower the chamber temperature to Y° F minimum and hold this temperature for six minutes minimum After this period, all switches shall have operated.

* 4.7.3.2.2 Liquid calibration method. Switches shall be placed in a well-agitated bath (no stratification of the liquid) which is capable of holding a given set temperature point of ±.5° F throughout the temperature range of the test. Switches shall be tested by a "go-no-go" method as used in inspection gages or by recording individual temperatures of each switch.

4.7.3.2.2.1 Individual temperature method The rate of temperature change shall not exceed 1°F per minute when the temperature is within 5°F of the operating temperature range

4 7 3 2 2 2 Go-no-go test procedure (for type I switches) Four controlled baths (see 4 7 3.2.2) shall be used The following tests may be entered at any step but tests must be conducted in the sequence shown, with step 1 following step 4

Step 1 - Stabilize a liquid bath (number 1) at X°F minimum Place switches in bath and allow to stabilize for five minutes minimum. Monitor the switches' electrical circuit. At end of this period, switches shall not have operated

Step 2 - Stabilize a liquid bath (number 2) at X°F maximum. Transfer switches from bath number 1 to bath number 2 and allow to stabilize for five minutes minimum. Monitor the switches' electrical circuit At end of this period, switches shall have operated.

Step 3 - Stabilize a liquid bath (number 3) at Y°F maximum. Transfer switches from bath number 2 to bath number 3. Allow switches to stabilize for five minutes minimum. Monitor the switches' electrical circuit At end of this period, switches shall not have operated.

Step 4 - Stabilize a liquid bath (number 4) at Y°F minimum. Transfer switches from bath number 3 to bath number 4. Allow switches to stabilize for five minutes. Monitor the switches' electrical circuit. At end of this period, switches shall have operated.

4.7.3.2.3 Surface block method. Switches shall be placed on a block and tested by a "go-no-go" method as used in inspection gages or by recording individual temperatures of each switch.

4 7.3.2.3.1 Individual temperature method. The rate of temperature change shall not exceed 1°F per minute when the temperature is within 5°F of the operating temperature range.

4 7 3.2.3 2 Go-no-go test procedure (for type II switches). Set the temperature of one liquid bath (block or oven) to a temperature equal to the switch nominal setting MINUS the setting tolerance. Set a second liquid bath (block or oven) to a temperature equal to the switch nominal setting PLUS the switch tolerance. Place the switch in the first bath and note the position of the contacts as shown by the indicator light. Transfer the switch to the second bath. The contacts must operate within one minute. Return the switch to the first bath The switch contacts must return to their original position within one minute. NOTE: When calibration block or oven is used, it may be more desirable to change the block or oven temperature instead of moving the switches. This method may be used provided the temperature is not changed faster than 1°F per minute, and the temperature variation does not exceed the bath temperatures defined above. The dwell time at maximum and minimum points may be two minutes

4.7 4 Creepage (applicable to type I switches only, see 3.9) Snap action switches shall be tested through three complete cycles. Switches shall be heated or cooled as required to cause thermal actuation. Switch opening and switch closing functions shall both be checked for creepage. Acceptable instrumentation for this test shall consist of one of the following setups:

(a) A low range (10 Ω or less midscale) undamped ohmmeter.
(b) A milliammeter in series with a resistance and power supply, with a microphone, amplifier, and loudspeaker system to audibly monitor disc "snap "
(c) Other instrumentation upon which the manufacturer can reliably demonstrate effective creepage detection.

Using the ohmmeter (a), the needle shall actuate instantly, without hesitation or interrupted action during its swing Using the loudspeaker-milliammeter setup (b), the audible snap of the switch shall occur simultaneously with the actuation of the meter, and the meter needle shall actuate instantly without hesitation or interruption of its swing The rate of change of temperature of the switch shall be the minimum practicable, consistent with normal production methods and reliable creepage detection.

4 7 5 Temperature response.

* 4.7 5.1 Sensitivity response test (see 3. 10) (when specified, see 3. 1 and 6. 1. 2). The switch shall be placed in a sensitivity test facility. One channel of the facility shall be adjusted to a temperature of 70°F ±5°F below the temperature set point of the switch under test, while the other channel of the facility shall be adjusted to 70°F ±5°F above the temperature set point of the switch under test The air shall be maintained at a velocity of 20 ±2 feet per second (ft/s) in both channels throughout the test The switch shall be inserted into the channel operating at the lower temperature, allowed to heat for at least 10 minutes, and then moved, within 1 second into the channel operating at the higher temperature. The time required for operation of the switch after it has been moved into the high temperature channel shall not exceed 10 seconds. The switch shall be allowed to soak for at least 10 minutes, after which it shall be moved back into the channel operating at the lower temperature The time required for the switch contacts to open after it has been moved into the lower temperature channel shall not exceed 10 seconds.

4 7.5 1 1 Sensitivity test facility. The sensitivity test facility shall be a gas-flow stove with two similar rectangular channels that can be operated separately at different temperatures The channels shall be located side by side so that the switch can be moved, by a sliding mechanism, from one channel to the other within 1 second. During the tests, only the temperature sensing portion of the switch need be immersed in the gas flow To prevent ambient air from being drawn into the channel where the switch goes through the channel wall, a slight overpressure on the test section may be maintained The cross section of the channel test section shall have at least a 1-inch clearance around the sensing element, except on the mounting side where the mounting flange touches the wall. The velocity distribution in the test section shall correspond to that of normal turbulent flow in a straight channel. At a distance of 10 percent of the channel width from the channel wall, the flow velocity shall be at least 75 percent of the center velocity The test section and the section upstream of the test section shall be insulated so that the wall temperature will not be more than 10 percent below the center temperature at the test section. The temperature measurement shall be made with a thermocouple, at least 1 inch of which is parallel to and in contact with the wall. Reference values for the test shall be the temperature and velocity, measured in the center of the channel. The temperature shall be measured 2-1/2 ± 1/2 inch upstream from the switch. The measurement shall be made with a 28 AWG (0.0126 inch) thermocouple. The thermocouple shall be located at least two channel widths from the outlet end of the channel The test section shall be protected from the radiant effect of any flame or surface having a higher temperature than the gas temperature

4.7.6 Temperature anticipation (see 3. 11) (when specified, see 3. 1 and 6. 1. 2). The switches shall be stabilized at -65° F for 1 hour Within 1 minute, the switches shall be inserted in a channel of the sensitivity facility at a temperature of 70° F ± 5° F below its actuating temperature with an air velocity of 20 ft/s, and allowed to remain for 3 minutes. Switches shall then meet the requirements of 3. 11

4 7.7 Seal (as applicable, see 3. 12) Switches shall be tested in accordance with 4.7 7.1, or 4.7 7.2, as applicable.

4.7.7.1 Hermetic. Switches shall be tested in accordance with method 112 of MIL-STD-202. The following details shall apply

(a) Test condition - C
  (1) Procedure III or IV, leakage-rate sensitivity - $1x10^{-8}$ atm cc/sec, for checking gross leaks, test condition B.
  (2) For procedure IV -
    (a) Reduced pressure of the chamber and duration of pressurization - Determination made in accordance with the type of equipment used.
(b) Measurements after test - None.

4.7.7.2 Watertight Switches shall be immersed to a depth of 6 ±2 inches in a container of water containing approximately 1/2 of 1 percent aerosol, and shall then be placed in a vacuum chamber The absolute pressure shall be 1 3 inches of mercury and this pressure shall be maintained for a period of 1 minute, or until air bubbles cease to be given off by the water, whichever is longer The absolute pressure shall then be increased to 2 5 inches of mercury and this pressure maintained for 2 minutes During the 2-minute period, the switches shall be observed for evidence of a continuous stream of bubbles Any bubbles coming from within the switches shall be considered as leakage Bubbles which are the result of entrapped air on the exterior of the switches shall not be considered as an indication of leakage

4.7.8 Dielectric withstanding voltage (see 3.13). Switches shall be tested in accordance with 4.7.8.1 and, when applicable (see 3.1 and 6.1.2), in accordance with 4.7.8.2 This test shall be performed with the switch in normal position, and shall then be repeated for other operating positions

4.7.8.1 At atmospheric pressure. Switches shall be tested in accordance with method 301 of MIL-STD-202. The following details shall apply:

(a) Magnitude of test voltage - 1,000 volts plus twice the working voltage for initial test and 1,000 volts for subsequent tests.
(b) Nature of potential - AC.
(c) Duration of application of test voltage - 1 minute for qualification and group B tests, 5 seconds for all other tests, at 20 percent higher voltage.
(d) Points of application of test voltage - Between all terminals and ground.
(e) Maximum leakage current - 500 microamperes
(f) Examination after test - Switches shall be examined for evidence of arcing and flashover.

4.7.8.2 At reduced barometric pressure. Switches designed for operation above 10,000 feet shall be tested as specified in 4.7.8.1, and in accordance with method 105 of MIL-STD-202 The following details and exception shall apply

(a) Method of mounting - Normal mounting means.
(b) Test condition - C or D, as applicable.
(c) Test voltage - 500 volts, unless otherwise specified (see 3.1 and 6.1.2).

4.7.9 Insulation resistance (see 3.14). Switches shall be tested in accordance with method 302 of MIL-STD-202. The following details shall apply:

(a) Test condition - B.
(b) Points of measurement - Between all terminals and frame or ground

4.7.10 Contact resistance (see 3.15). Switch contacts shall be tested in accordance with method 307 of MIL-STD-202. The following details and exception shall apply

(a) Measurements - Between the terminals of the contacts of the same pole forming a switching circuit, for all poles in a switch at each of the temperature settings, between mated contacts for all poles.
(b) Test current - 0.1 ampere ± .005
(c) Test voltage - 6 ± 1/2 volts dc
(d) Number of activations prior to measurement - Not applicable.
(e) Number of test activations - Three.
(f) Number of measurements per activation - One reading after each thermal actuation

4.7.11 Thermal shock (see 3.16). Switches shall be tested in accordance with method 107 of MIL-STD-202. The following details and exception shall apply

(a) Test condition - B.
(b) Measurement before and after cycling - Not applicable.
(c) Examination after test - The temperature settings shall be within the tolerances specified (see 3.1, 6.1.2, and 3.5.3)

4.7.12 Terminal strength (see 3.17). Switches shall be tested in accordance with method 211 of MIL-STD-202. The following details and exceptions shall apply:

(a) Test condition - A.
(b) Applied force - 4-1/2 pounds. For wire lead terminals, the applied force shall be 15 pounds
(c) Direction of force - Force shall be applied along three mutually perpendicular axes of the terminal, one direction of which shall be the one most likely to cause failure
(d) Time duration - One minute.
(e) Examinations after test - Switches shall be examined for evidence of breaking, loosening, cracking, and other damage affecting the operation of the switch (Bending of terminals shall not be considered as damage to the switch)

4.7.13 Moisture resistance (see 3.18) Switches shall be tested in accordance with method 106 of MIL-STD-202. The following details and exceptions shall apply

(a) Mounting - Switches shall be mounted on a corrosion-resistant metal panel with the terminal-header side and sensing element exposed to chamber ambient conditions.
(b) Polarization voltage - During steps 1 to 6 inclusive, a polarizing voltage of 100 volts dc shall be applied between all terminals tied together and the metal panel. The negative polarity shall be applied to the metal panel.
(c) Steps 7a and 7b - Not applicable.
(d) Loading voltage - Not applicable.
(e) Final measurements - Within 5 minutes after removal from the chamber, and while the switches are still wet, insulation resistance shall be measured as specified in 4.7.9. At the end of the drying period, insulation resistance shall again be measured as specified in 4.7.9
(f) Examinations during final measurement and after test - Switches shall be examined for evidence of corrosion, breaking, cracking, and spalling

4.7.14 Flame response (when specified, see 3.1 and 6.1.2) (see 3.19). The switches shall be subjected to a flame of 2,000° F ± 50° F that envelops the sensing element of the switch for 1 minute. This cycle shall be repeated 3 times and shall meet the requirements of 3.19 each time.

* 4 7 15 Short circuit (see 3 20). Switches shall be inserted in a circuit which has been calibrated using a dummy switch, and which will supply a current equal to 15 times the rated resistive load at the lowest dc voltage specified (see 3.1), when monitored through the switch contacts. Each switch shall be connected in series, by 1-foot lengths of wire, to a thermal-type circuit breaker or a fuse in accordance with figure 1 and table V. A circuit breaker shall be used for switches having a rated resistive load of 5 amperes or greater, and a fuse for switches having a rated resistive load less than 5 amperes. The wire shall be of a size for use in free air as listed in MIL-W-5086 and table V, determined by the rated resistive load of the switch (see 3 1). If the rated load of the switch does not coincide with a wire size, the next larger wire size shall be used. The terminals shall be in accordance with MIL-T-7928. The circuit breaker shall be in accordance with MIL-C-5809 and table V, and fuses shall be in accordance with MIL-F-15160 and table V, and of the same current rating as the resistive current rating of the switch Calibration shall be made without the circuit breaker (or fuse), test switch, or switch leads in the circuit. With both the switch under test and the circuit breaker in a closed position, and with switch S_2 in the position shown on figure 1, the circuit shall be closed manually by switch S_1. A minimum of 2 minutes shall elapse between the successive closings of the switch. The test shall be conducted five times.

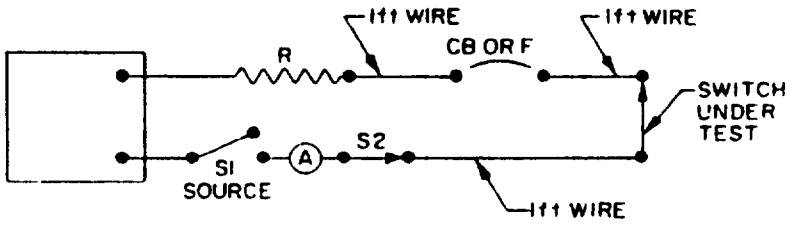

FIGURE 1 Circuit diagram for short circuit test.

TABLE V Short circuit wire size and circuit breaker or fuse designations.

Resistive rating at lowest voltage, amperes	Specification MIL-W-5086 wire size	Circuit breaker or fuse
Less than 5 - - - - - - - - -	AN-20	MIL-F-15160/2, characteristic A, rating, as applicable
5 - - - - - - - - -	AN-20	MS25017-5
7.5 - - - - - - - -	AN-18	MS25017-7
10 - - - - - - - - -	AN-18	MS25017-10
15 - - - - - - - - -	AN-18	MS25017-15
18 - - - - - - - - -	AN-16	MS25017-20
20 - - - - - - - - -	AN-16	MS25017-20
25 - - - - - - - - -	AN-14	MS25017-25
30 - - - - - - - - -	AN-14	MS25017-30
40 - - - - - - - - -	AN-12	MS25017-50

4.7.16 Vibration (see 3.21) Switches shall be tested in accordance with the applicable test methods of MIL-STD-202, as follows

(a) Method and test condition
  (1) For switches of classes 1 and 2 - Method 201
  (2) For switches of class 3 - Method 204 (vibration, high frequency), test condition - A.
  (3) For switches of classes 4 and 6 - Method 204, test condition - D
  (4) For switches of class 5 - Method 204, 10 to 3,000 Hz, 50G
(b) Tests and measurements prior to vibration - Not applicable
(c) Mounting - The switches shall be rigidly mounted by their normal mounting means on a rigid metal panel The mounting fixture shall be free from resonances over the test frequency range.
(d) Electrical load conditions - The switches shall be functioning with voltage and current specified (see 3.1 and 6.1.2) throughout resonance search and vibration tests. If no voltage or currents are specified, the test voltage shall be 28 volts dc
(e) Tests and measurements during vibration:
  (1) Resonance search - With the switch exposed to a temperature 5° F above the operate point, sweep slowly through frequency range and monitor for contact closure of more than 10 microseconds by use of an oscilloscope or recording oscillograph, which has a frequency response of at least 5,000 Hz Repeat with unit exposed to temperature 5° F below the operate point
  (2) Vibration endurance - With vibration frequency set to the critical resonant point or cycling frequency if there is no resonance, and amplitude specified for the corresponding frequency, cycle the switch temperature through the operating point at a rate not exceeding 5° F per minute with extremes not exceeding ±10° F around the operate point Contact transfers within 3° F of the operate point will be disregarded, and the cycling rate shall be a minimum of 5 cycles per hour

4.7.17 Shock (see 3.22) Switches shall be tested in accordance with 4.7.17.1 or 4.7.17.2, as applicable (see 3.1 and 6.1.2).

4.7.17.1 Method I (shock, specified pulse) (applicable to classes 1, 3, 4, 5, and 6) Switches shall be tested in accordance with method 213 of MIL-STD-202 The following details and exceptions shall apply

(a) Mounting method and accessories - Switches shall be mounted on a rigid metal panel by their normal mounting means
(b) Test condition - H for classes 1 and 3, I, for classes 4 and 6, D, for class 5.
(c) Electrical-load and thermal conditions - Half of the units shall be tested with the contacts closed while the other half shall be tested with the contacts open. The electrical load shall consist of the monitor circuit only
(d) Measurements during shock - Switch-contact stability shall be continuously monitored by means of method 310 of MIL-STD-202
(e) Examinations after test - Switches shall be examined for change in operation, and evidence of broken, deformed, displaced, and loose parts

4 7.17.2 Method II (high-impact shock) (applicable to class 2 only). Switches shall be tested in accordance with method 207 of MIL-STD-202. The following details and exceptions shall apply

(a) Mounting fixtures - As specified in 4.7 17.1(a).
(b) Electrical-load conditions - As specified in 4 7.17 1(c)
(c) Measurements during shock - Switch-contact stability shall be monitored for each blow by means of method 310 of MIL-STD-202. In the event of indication of contact opening greater than 5 milliseconds, the test shall be modified by applying successive identical blows in the same plane to monitor contacts, switch by switch, to determine if a switch is defective
(d) Measurements after shock - Not applicable.
(e) Examinations after test - Switches shall be examined for change in operation, and evidence of broken, deformed, displaced, and loose parts

4 7 18 Overload cycling (see 3.23). Each switch shall be tested for overload cycling using the same voltage, electrical frequency, and the same pair(s) of contacts that will subsequently be used for the electrical endurance test The switches shall close and open the overload current of a resistive circuit equal to 150 percent of the resistive load rating at the particular voltage and electrical frequency. The cycling rate shall be 5 to 6 cycles of operation per minute Fifty cycles of operation shall be performed The duty cycle shall be approximately 50 percent on, 50 percent off

4.7.19 Endurance (see 3.24) Switches shall be subjected to the specified number of cycles of make-and-break operations at a cycling rate of 6 cycles per minute maximum at the rated loads (see 3.1 and 6.1.2).

4.7.20 Salt spray (corrosion) (see 3.25). Switches and their mounting hardware and brackets (if applicable) shall be tested in accordance with method 101 of MIL-STD-202. The following details shall apply

(a) Applicable salt solution - 5 percent.
(b) Test condition - B.
(c) Measurements after exposure - Following the drying period, the switches shall meet the requirements specified in 3.25 Mounting hardware shall be removed at the end of the test.

4 7 21 Sand and dust (see 3.26) (when specified, see 3.1 and 6.1.2). Switches shall be tested in accordance with method 110 of MIL-STD-202. This test shall be performed with the pressure port suitably capped or plugged. The following details shall apply·

(a) Test condition - B.
(b) Measurements - Switches shall be tested in accordance with 4.7.3.

4 7 22 Explosion (see 3.27) (when specified, see 3.1 and 6.1.2). Switches shall be tested in accordance with method 109 of MIL-STD-202. The following detail shall apply

(a) Mechanical and electrical load - Switches shall be operated at their maximum rated dc inductive current (see 3.1 and 6.1.2).

5. PREPARATION FOR DELIVERY

5 1 Preparation for delivery. Switches shall be prepared for delivery in accordance with MIL-S-28786.

6 NOTES

6 1 Ordering data

* 6 1 1 For switches covered by specification sheets Procurement documents should specify the following

(a) Title, number, and date of this specification
(b) Title, number, and date of the applicable specification sheet and the complete military part number

* 6 1 2 For switches not covered by specification sheets Procurement documents should specify the following

(a) Title, number, and date of this specification
(b) Operating temperature and operating temperature ranges (see 1 1)
(c) Type and class required (see 1.2 1 and 1.2.2)
(d) Manufacturer's part number (see 3 28)
(e) Other type of plastic insulation, if required (see 3 4 1)
(f) Details of design, construction, physical dimensions, mounting means, and weight (see 3.5)
(g) Operating points and tolerances (see 3 8).
(h) Creepage, if applicable (see 3.9)
(i) Seal (as applicable) (see 3 12)
(j) Dielectric withstanding voltage

(1) If maximum leakage current is in excess of that specified (see 3 13)
(2) Test method, and if required, magnitude of test voltage and test condition letter (see 4 7.8).

(k) Contact resistance, if other than as specified (see 3 15)
(l) Vibration

(1) If contact opening and closing is not as specified (see 3 21)
(2) Electrical load conditions (see 4 8 17)

(m) Shock

(1) If contact opening and closing is not as specified (see 3 22).
(2) Applicable method (see 4 7 17)

(n) Number of cycles for endurance test (see 4 7 19)

6 2 Qualification With respect to products requiring qualification, awards will be made only for products which are at the time set for opening of bids, qualified for inclusion in the applicable qualified products list, whether or not such products have actually been so listed by that date The attention of the suppliers is called to this requirement, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or orders for the products covered by this specification The activity responsible for the qualified products list is the Naval Electronic Systems Command, Washington, D C 20360, however, information pertaining to qualification of products may be obtained from the Defense Electronics Supply Center (DESC-E), Dayton, Ohio 45401

6.2.1 Copies of "Provisions Governing Qualification" may be obtained upon application to Commanding Officer, Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, Pennsylvania 19120.

6.3 Intermetallic contact The finishing of metallic areas to be placed in intimate contact by assembly presents a special problem, since intermetallic contact of dissimilar metals results in electrolytic couples which promote corrosion through galvanic action. To provide the required corrosion protection, intermetallic couples are restricted to those permitted by table VI Table VI shows metals and alloys (or plates) by groups which have common electromotive forces (EMF) within 0.05 volt when coupled with a saturated calomel electrode in sea-water at room ambient temperatures. All members of a group are considered as completely compatible, one with the other. Compatible couples between groups have been specified in table VI based on a potential difference of 0.25 volt maximum. To simplify any arithmetic involved, table VI shows, in addition to EMF against a calomel electrode, a derived "anodic index" with group 1 (gold, and so forth) as 0 and group 18 (magnesium, and so forth) as 175. Subtraction of a lower group anodic index gives the EMF difference in hundredths of a volt

6 3 1 Groups. Table VI sets up 18 primary groups It may be noted that neither the metallurgical similarity or dissimilarity of metals is the parameter for selection of compatible couples. All members within a group, regardless of metallurgical similarity, are considered inherently nonsusceptible to galvanic action when coupled with any member within the group, for example, such dissimilar metals as platinum and gold. Similarly, such basically dissimilar alloys as austenitic stainless steel, silver-solder, and low brass (all members of group 5) are inherently nonsusceptible when coupled together.

6.3.2 Compatibility graphs. Permissible couple series are shown in table VI by the graphs at the right. Members of groups connected by lines will form permissible couples. A "O" indicates the most cathodic member of each series, a "●" an anodic member, and the arrow indicates the anodic direction.

6.3.3 Selection of compatible couples. Proper selection of metals in the design of equipment will result in fewer intermetallic contact problems. For example, for sheltered exposure, neither silver nor tin require protective finishes. However, since silver has an anodic index of 15 and tin 65, the EMF generated as a couple is 0.50 volt, which is not allowable by table VI. In this case, other metals or plates will be required It should be noted that, in intermetallic couples, the member with the higher anodic index is anodic to the member with the lower anodic index and will be susceptible to corrosion in the presence of an electrolytic medium. If the surface area of the cathodic part is significantly greater than that of the anodic part, the corrosive attack on the contact area of the anodic part may be greatly intensified. Material selection for intermetallic contact parts, therefore, should establish the smaller part as the cathodic member of the couple, whenever practicable.

6.3.4 Plating. When base metals intended for intermetallic contact form couples not allowed by table VI, they are to be plated with those metals which will reduce the potential difference to that allowed by table VI.

6 4 The margins of this specification are marked with an asterisk to indicate where changes (additions, modifications, corrections, deletions) from the previous issue were made. This was done as a convenience only and the Government assumes no liability whatsoever for any inaccuracies in these notations. Bidders and contractors are cautioned to evaluate the requirements of this document based on the entire content irrespective of the marginal notations and relationship to the last previous issue.

TABLE VI Compatible couples (see 6.3). 1/

Group No	Metallurgical category	EMF (volt)	Anodic index (0.01 v)	Compatible couples
1	Gold, solid and plated, gold-platinum alloys, wrought platinum (most cathodic)	+ 0.15	0	
2	Rhodium plated on silver-plated copper	+ 0.05	10	
3	Silver, solid or plated, high silver alloys	0	15	
4	Nickel, solid or plated, monel metal, high nickel-copper alloys	- 0.15	30	
5	Copper, solid or plated, low brasses or bronzes, silver solder; German silver, high copper-nickel alloys; nickel-chromium alloys, austenitic corrosion-resistant steels	- 0.20	35	
6	Commercial yellow brasses and bronzes	- 0.25	40	
7	High brasses and bronzes, naval brass, Muntz metal	- 0.30	45	
8	18 percent chromium type corrosion-resistant steels	- 0.35	50	
9	Chromium, plated, tin, plated, 12 percent chromium type corrosion-resistant steels	- 0.45	60	
10	Tin-plate, terneplate, tin-lead solder	- 0.50	65	
11	Lead, solid or plated, high lead alloys	- 0.55	70	
12	Aluminum, wrought alloys of the duraluminin type	- 0.60	75	
13	Iron, wrought, gray, or malleable, plain carbon and low alloy steels, armco iron	- 0.70	85	
14	Aluminum, wrought alloys other than duraluminin type, aluminum, case alloys of the silicon type	- 0.75	90	
15	Aluminum, cast alloys other than silicon type, cadmium, plated and chromated	- 0.80	95	
16	Hot-dip-zinc plate; galvanized steel	- 1.05	120	
17	Zinc, wrought; zinc-base die-casting alloys; zinc, plated	- 1.10	125	
18	Magnesium and magnesium-base alloys, cast or wrought (most anodic)	- 1.60	175	

1/ Compatible couples - potential difference of 0.25 volt maximum between groups.

Custodians
Army - EL
Navy - EC
Air Force - 11

Review activities
Army - EL, MU, MI
Navy - EC, AS, OS
Air Force - 11, 17, 80
DSA - ES

User activities:
Army - ME, AT, AV, SM
Navy - MC, CG, SH
Air Force - 19

Preparing activity
Navy - EC

Agent:
DSA - ES

(Project 5930-0820)

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

(See Instructions – Reverse Side)

1. DOCUMENT NUMBER	2. DOCUMENT TITLE

3a. NAME OF SUBMITTING ORGANIZATION	4. TYPE OF ORGANIZATION *(Mark one)*
	☐ VENDOR
b. ADDRESS *(Street, City, State, ZIP Code)*	☐ USER
	☐ MANUFACTURER
	☐ OTHER *(Specify)* _____

5. PROBLEM AREAS

a. Paragraph Number and Wording

b. Recommended Wording

c. Reason/Rationale for Recommendation

6. REMARKS

7a. NAME OF SUBMITTER *(Last, First, MI)* – Optional	b. WORK TELEPHONE NUMBER *(Include Area Code)* – Optional
c. MAILING ADDRESS *(Street, City, State, ZIP Code)* – Optional	8. DATE OF SUBMISSION *(YYMMDD)*

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